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EFFECT OF AGRICULTURE ON WATER QUALITY AND USE IN THE WABASH RIVER BASIN

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Evansville, Indiana

April 1968

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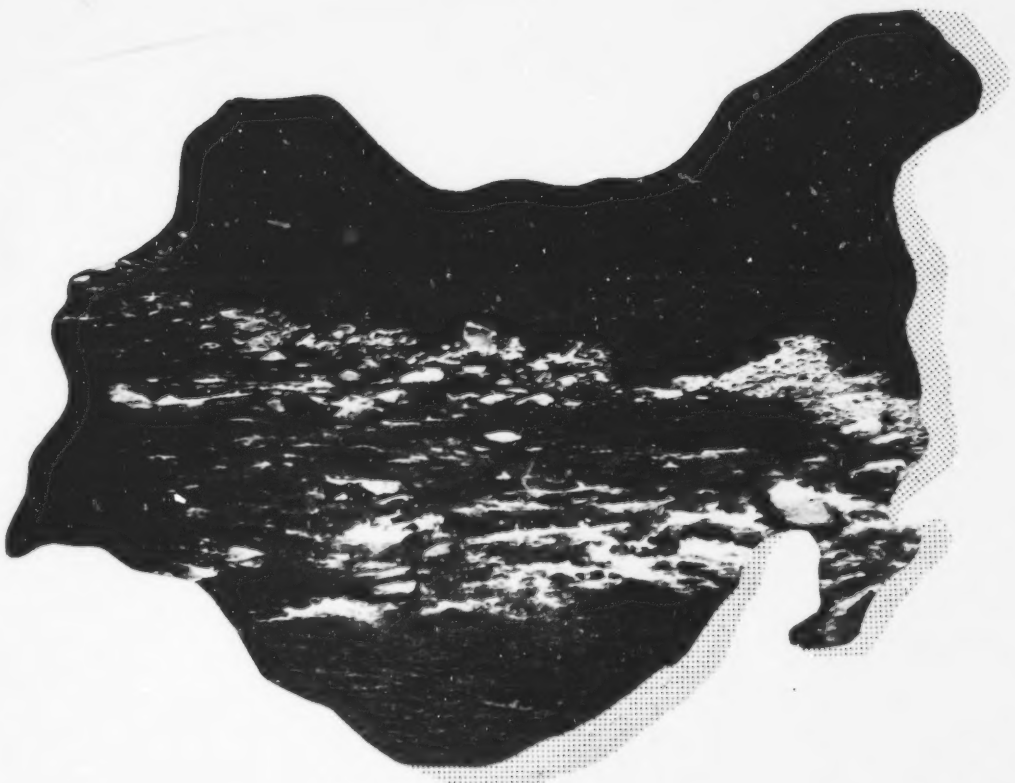

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UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION
OHIO RIVER BASIN PROJECT

EVANSVILLE FIELD STATION, INDIANA

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Work Document No. E5

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This document has been prepared to record a specific water pollution control activity carried out to date in the furtherance of the water pollution control program being developed in the Ohio River Basin. This information contained herein will serve as a ready reference to aid the planning and development of the program in the Basin, for appropriate in-service training of participating personnel, and facilitating program activities with other cooperating groups.

Questions or comments relative to this material should be directed to:

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UNITED STATED DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION
OHIO RIVER BASIN PROJECT

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I. INTRODUCTION

Purpose and Scope

The purpose of this document is to appraise the various aspects of the effect of agriculture on water quality and use in the Wabash River Basin and to make recommendations on how agricultural pollution may be feasibly reduced.

Subjects covered include: (1) description and interpretation of the major soils, particularly as they relate to water supply and quality; (2) historical and current agricultural water usage; (3) agricultural economy of the basin; (4) effects of land use, erosion, sedimentation, agricultural chemicals and livestock feedlots on water quality; and (5) steps that can be taken to reduce agricultural pollution of water, such as proper land use, application of feasible soil conservation practices, correct use of fertilizer and pesticides, and proper management of livestock wastes.

The document includes projections for the years 1980, 2000, 2020, based on expected population growth and development. The projections are for agricultural water use, agricultural production, timber production, and land use.

Authority

This document has been prepared in accordance with Section 3(a) of the Federal Water Pollution Control Act as amended (33 USC 466 et seq.).

II. SUMMARY AND CONCLUSIONS

1. Summary

Favorable soil and topographic conditions make the Wabash River Basin one of the nation's most intensively farmed areas. With good management the soils are moderately to very highly productive, with a large part being highly to very highly productive. In the southern counties, a generally rugged terrain and shallow soils cause more of the acreage to be used for woodland. Over one-half of the soils are moderately permeable, a condition favorable to ground water recharge. Most of the remaining soils are slowly permeable and ground water recharge may usually be slow(1).

In 1964 livestock used 27,180,000 gallons of water per day and rural farm domestic use was 10,360,000 gallons per day (2). Specialty crops on 6,752 acres were irrigated with 5,400 acre-feet of water(2).

Seventy-four percent of the basin is cropland and pasture, and 15 percent is forest land(2). Farm crops, livestock, dairy products, and poultry and eggs are the chief sources of agricultural income(3).

Soil conservation practices have not been applied to 65 percent of the cropland, and sloping land in all parts of the basin is subject to soil erosion. This results in silt pollution of streams and deposits of sediment in reservoirs. A known method to reduce silt pollution and sediment deposition to a feasible minimum is to put every acre of agricultural land in the basin to its best use and apply appropriate

soil conservation practices. This will also reduce pesticides and nutrients, phosphorus and nitrogen compounds, in runoff water to a practical minimum.

Most of the animal wastes from large feedlots are spread on the land; some are treated in lagoons. Wastes from 21 large feedlots are not spread on the land or treated in lagoons and are a likely source of surface water pollution.

Selective use of pesticides and the use of alternate methods of pest control will reduce toxic, contaminant sources of pollution. Wherever possible, rapidly degradable pesticides should be used instead of non-degradable or slowly degradable agents.

2. Conclusions

Silt pollution of surface water and sedimentation of reservoirs is a serious problem in the Wabash River Basin. Nutrients, phosphorus and nitrogen compounds, in runoff from cropland are high enough to stimulate nuisance algal blooms in reservoirs. Pollution from livestock feedlots may have localized effects on surface water quality. Proper agricultural use of pesticides is no serious threat to surface water quality at this time.

Projections to 2020 indicate: (1) a decrease in cropland; (2) acreage of pasture land will more than double; (3) water used by livestock will increase 3.6 times, and irrigation will increase 79 times during years of average rainfall(2).

Agriculture can contribute to more efficient water use by putting each acre of land to its best use, using all suitable soil conservation practices, using all feasible agronomy practices which will result in the highest possible crop yields, and constructing farm ponds where needed. The above mentioned methods are also the most effective means of reducing pollution of surface water by runoff water.

III. SOILS

Favorable soil and topographic conditions make the Wabash River Basin one of the nation's most intensively farmed areas. As a consequence, accelerated soil erosion caused by cultivation of the soil is a problem throughout the basin.

In their virgin state, most of the soils were well supplied with organic matter. Their good structure helped them to absorb and transmit rainfall so when the land was first cleared and cropped, erosion was not a problem. Continued cropping lowered the organic matter content and broke down the soil structure. This lowered the soils capacity to absorb rainfall and resulted in accelerated erosion, particularly on sloping land.

During the past 30 years, adoption of soil conserving practices has helped to reduce soil erosion. This should be accelerated until all feasible soil conservation practices have been applied to land throughout the basin.

Soil Associations of the Wabash River Basin

A5 Brenton-Martinton-Rensselaer - These nearly level to gently sloping, dark colored, medium acid to neutral silt loam, loam, sandy loam, or silty clay loam soils developed on moderately coarse to moderately fine textured outwash and lacustrine sediments which are usually limy at

depths of 40 to 60 inches. Sloping soils are somewhat poorly to well drained and subject to erosion. Depressional soils are wet, except where artificially drained. Permeability ranges from moderate to slow. These productive soils are mostly used for grain farming.

A6 Saybrook-Parr-Drummer - These nearly level to sloping, dark colored, medium acid to neutral silt loam to silty clay loam soils developed on loess up to two feet thick over limy loam till. Sloping soils are well drained and subject to erosion. Depressional soils are wet except where artificially drained. Permeability ranges from moderate to slow. These highly productive soils are mostly used for grain farming.

A8 Flanagan-Drummer-Sidell - These nearly level to sloping, dark colored, medium acid silt loam or nearly neutral silty clay loam soils developed on 18 to 60 inches of loess over loam till which is limy at depths of 42 to 60 inches. Sloping soils are well drained and subject to erosion. Depressional soils are wet, except where artificially drained. Permeability ranges from moderate to slow. These highly productive soils are mostly used for grain farming.

A25 Elliott-Ashkum - These nearly level to sloping, poorly to moderately well drained soils developed on limy silty clay loam till. The dark colored, medium acid Elliott silt loam is on slopes, and the very dark colored, nearly neutral Ashkum silty clay loam is in depressions.

Slopes are erosive and drainage is inadequate in depressions. Permeability is slow. These productive soils are responsive to good management and are used for grain farming.

A27 Swygert-Bryce-Clarence - These nearly level to sloping, dark colored silt loam to silty clay loam soils developed on limy silty clay (Swygert and Bryce) and clay till (Clarence). These soils are so slowly permeable that erosion is serious, even on gentle slopes, and adequate drainage is difficult to obtain in level areas. These productive soils are used for cash-grain farming.

F5 Fox-Oshtemo-Warsaw - These nearly level to gently sloping, well drained, medium to slightly acid silt loam to sandy loam soils have sandy clay loam subsoils. They developed on limy gravelly and sandy glacial drift of Wisconsin age and are limy at depths of 24 to 60 inches. Fox and Oshtemo soils are grayish brown and Warsaw is very dark brown. Associated depressions are wet unless artificially drained. These soils are moderately rapid to rapidly permeable and are frequently underlain by deep deposits of gravel and sand which are excellent aquifers. They are moderately low in moisture supplying capacity and fertility and are erosive on the more sloping areas. These soils are moderately productive for grain and livestock farming.

F8 Tracy-Door - These level to gently sloping, well to excessively drained, medium to strongly acid loam to sandy soils have sandy clay

loam and clay loam subsoils. They developed on acid gravelly sand and are usually acid to depths of 42 to 66 inches. Tracy is light brown and Door is very dark brown. These soils are moderately permeable and low in moisture supplying capacity, fertility, and organic matter. They are moderately productive, respond to good management, and are mostly used for grain and livestock farming.

F10 Princeton-Bloomfield - These well to excessively drained gently rolling uplands and stabilized dunes border the lower Wabash and West Fork White River in Indiana. They are light colored, slightly acid silt loam to loamy fine sand soils that developed on aeolian fine sand to coarse silt. These soils are moderately rapid in permeability and low to moderate in moisture supplying capacity, fertility, and organic matter. Erosion is a hazard on the sloping, silty soils. These soils respond to good management and are mostly used for livestock farming. Orchards, melon, and truck crops prevail on the sandier soils.

F15 Miami-Crosby - These nearly level to moderately steep, light colored, medium to slightly acid silt loam to sandy loam soils developed in limy loam till. Miami is sloping and well drained; Crosby is nearly level and somewhat poorly drained. These soils are moderately high in productivity and moderate in permeability, moisture supplying capacity, fertility, and organic matter. Crosby is artificially drained. Erosion is a hazard on sloping areas. Mixed grain and livestock farming is practiced.

F16 Birkbeck-Pecatonica-Russell - These nearly level to moderately steep, light colored, well to somewhat poorly drained, slightly to medium acid silt loam soils developed in 18 to 60 inches of loess on limy loam to sandy loam till. These soils are moderately high in productivity and moderate in permeability, moisture supplying capacity, fertility, and organic matter. Erosion is a hazard. These soils are mostly used for grain and livestock farming.

F19 Menfro-Alford-Hosmer - These gently sloping to steep, well to moderately well drained, light colored, medium acid silt loam soils developed in deep to moderately deep loess. They are moderately to slowly permeable, moderate in moisture supply capacity, moderate to low in fertility, acid, and low in organic matter. Erosion is a hazard. Livestock and mixed farming is practiced; steeper slopes are in permanent pasture or woodlots.

F25 Morley-Blount-Pewamo - These nearly level to moderately steep, slightly to medium acid, moderately to very highly productive soils developed on limy clay loam till. Morley silt loam is light colored, sloping to moderately steep, and moderately well drained. Blount silt loam is light colored, nearly level to gently sloping, and somewhat poorly drained. Pewamo silty clay loam is dark colored, depressional, very poorly drained, and high in moisture supplying capacity, fertility, and organic matter. Morley and Blount are moderate in moisture supplying

capacity, fertility, and organic matter. Pewamo and Blount are mostly tile drained. Erosion is a hazard on slopes. These soils are slowly permeable. Grain and livestock farming predominates.

G1 Plainfield-Granby-Zimmerman - In these level to sloping soils, sand dunes are common. Plainfield and Zimmerman sands and loamy sands are light colored, well to excessively drained, medium to very strongly acid, subject to wind erosion, and low in moisture supplying capacity, fertility, and organic matter. Granby sand to sandy loam is dark colored, slightly acid to neutral, and moderate in moisture supplying capacity, fertility, and organic matter. It is wet, except where artificially drained. The soils in this association are rapidly permeable. They are used for vegetables, fruits, berries, and a small amount of grain crops. Large areas are in second growth forest or idle land. Some areas are used for public recreation or rural residences. Where Granby soils predominate, they are well suited to and used for cash-grain farming.

G5 Miami-Crosby-Brookston - These nearly level to sloping, moderately high to very highly productive, medium to slightly acid soils developed in limy loam till. Miami silt loam is light colored, sloping, and well drained. Crosby silt loam is light colored, nearly level, and somewhat poorly drained. Brookston silty clay loam is dark colored, depressional, and high in moisture supplying capacity, fertility, and organic matter.

Brookston and Crosby are mostly artificially drained. Miami and Crosby are moderate in moisture supplying capacity, fertility, and organic matter. Erosion is a hazard on sloping areas. These soils are moderately permeable. They respond to good management and are used for grain and livestock farming.

G6 Russell-Fincastle-Brookston - These nearly level to sloping, moderately high to very highly productive, medium to slightly acid soils developed in 18 to 40 inches of loess on loam till which is limy at depths of 40 to 60 inches. Russell silt loam is light colored, sloping, and well drained. Fincastle silt loam is light colored, nearly level, and somewhat poorly drained. Brookston silty clay loam is dark colored, depressional, and high in moisture supplying capacity, fertility, and organic matter. Brookston and Fincastle are mostly tile drained. Russell and Fincastle are moderate in moisture supplying capacity, fertility, and organic matter. Erosion is a hazard on sloping areas. These soils are moderately permeable. They respond to good management and are used for grain and livestock farming.

G8 Blount-Pewamo-Morley - These nearly level to sloping, moderately to very highly productive, slightly to medium acid soils developed on limy clay loam till. Blount silt loam is light colored, level to gently sloping, and somewhat poorly drained. Morley silt loam is light colored, sloping, and moderately well drained. Pewamo silty clay loam is dark

colored, depressional, very poorly drained, and high in moisture supplying capacity, fertility and organic matter. Pewamo and Blount are mostly tile drained. Morley and Blount are moderate in moisture supplying capacity, fertility, and organic matter. Erosion is a hazard on slopes. These soils are slowly permeable. Grain and livestock farming predominates.

G10 Montgomery-McGary - These nearly level soils developed on limy slack water clay loam to clay deposits that are leached to a depth of about three feet. McGary silt loam is light colored, acid, somewhat poorly drained, and moderate in productivity, moisture supplying capacity, fertility, and organic matter. Montgomery silty clay loam is dark colored, neutral, very poorly drained, and high in productivity, moisture supplying capacity, fertility, and organic matter. These soils are slowly permeable. They are mostly artificially drained. Grain and livestock farming predominates.

H2 Muskingum-Keene-Wellston - This is a highly dissected upland area with deep v-shaped valleys, steep wooded slopes, and narrow ridgetops. These light colored, excessively to moderately well drained, medium to strongly acid, silt loam, stony silt loam, and sandy loam soils developed in residuum of siltstone, shale, and sandstone with some shallow loess deposits. These soils are low in organic matter and fertility and moderate to low in productivity and moisture supplying capacity. They

are moderately to slowly permeable and erosion is a hazard. These areas are mainly in woodlands with some general farming and fruit farming.

H4 Muskingum-Zanesville - These silt loam soils are nearly level to steep, light colored, well drained, and medium to strongly acid. Zanesville is on gently sloping ridgetops and has a fragipan. They developed in moderately deep loess on siltstone, sandstone, and shale. Muskingum is on steep slopes and developed in residuum of siltstone, shale, and sandstone. The soils in this association are moderate to low in productivity, moisture supplying capacity, fertility, and organic matter. Erosion is a hazard. They are moderately to slowly permeable. Hosmer and Wellston soils occur in the western part of the area. These soils are mostly used for general farming, with some dairy and livestock farming.

I4 Cincinnati-Rossmoyne-Fairmount - These light colored, well to moderately well drained soils occur on nearly level to steep areas. Cincinnati and Rossmoyne silt loams are strongly acid, low in fertility, and moderate in moisture supplying capacity, organic matter, and productivity. They developed in loess overlying limy clay loam till of Illinoian age. Fairmount silty clay loam is steep, drouthy, and neutral. It developed in residuum of limestone and shale. In this association, erosion is a hazard and permeability is slow. General farming is practiced and steep areas are in forest and pasture.

I7 Frederick-Crider-Pembroke - These level to gently sloping, light colored, well drained, acid silt loams developed in moderately deep loess over the residuum of high grade and cherty limestone. These soils are moderate to low in moisture supplying capacity and low in fertility and organic matter. Erosion is a hazard and permeability is moderate. The area is moderately productive for livestock farming.

05 Hoyleton-Cisne - These dark colored, acid, somewhat poorly to poorly drained, nearly level to gently sloping soils have silt loam surfaces and claypan subsoils. They developed in less than 65 inches of loess underlain by weathered Illinoian till. These soils are low in fertility and moderate in organic matter, moisture supplying capacity, and productivity. Claypan subsoils do not permit tile to function properly and level areas must be drained with open ditches. Erosion is a hazard on slopes. Permeability is very slow. These soils are used for general farm crops and livestock farming.

06 Bluford-Vigo-Clermont - These light colored, level to sloping, poorly to moderately well drained, strongly acid silt loams developed on 30 to 70 inches of loess over weathered Illinoian till. These soils are very slowly permeable because of claypans or fragipans. Level areas must be drained with open ditches and erosion is a hazard on slopes. They are low in organic matter and fertility and moderately low in moisture supplying capacity and productivity. These soils are used for mixed grain and livestock farming.

07 Robinson-Otwell - These light colored, level to gently sloping, acid silt loams developed in acid lacustrine material. These soils are moderately low in moisture supplying capacity and productivity and low in fertility and organic matter. They are slowly permeable and drainage is poor on level areas. Slopes are erosive. These soils are used for mixed grain and livestock farming.

Q3 Genesee-Huntsville-Wabash - These nearly level, well to poorly drained, brown to black, nearly neutral loam to silty clay loam soils developed in alluvium from glacial drift and loess. On associated terraces, there are limited areas of well drained light colored, medium acid soils developed in silt and sand on limy gravel. These soils are high in moisture supplying capacity, organic matter, fertility, and productivity. Permeability is moderate to moderately rapid. Corn is the principal crop. Unprotected areas subject to flooding are used for pasture and timber.

Q4 Waverly-Bonnie-Philo - These nearly level, moderately to poorly drained, moderately light colored, acid soils developed in loam to silty clay loam alluvium. They are moderate in permeability and moisture supplying capacity and moderate to low in fertility, organic matter and productivity. Corn is the principal crop. Undrained and unprotected areas are used for pasture or timber(1).

IV. ECONOMY OF THE AREA

1. Agriculture and Forestry

The Wabash River Basin contains 21,018,000 acres, of which 15,486,000 acres or 74 percent are crop and pasture land, and 3,134,000 acres or 15 percent are forest land(2). Farm crops and livestock are the most important sources of agricultural income in the basin(3).

Favorable soil and topographic conditions make the basin one of the nation's most intensively farmed areas. The northern part is in the corn belt and has a prosperous agricultural economy based on corn, soybeans, and stock raising. Truck farming is locally important in the headwaters areas of the White and Wabash Rivers(5). With the use of lime, fertilizer, improved crop varieties, and other good farm practices, the cultivated soils are moderately to very highly productive, with a large part being highly to very highly productive.

In the southern counties, because of a generally rugged terrain and shallow soils, more of the acreage is used for woodland and other less intensive agricultural development.

Urban growth since World War II has been using good agricultural land. This is mostly confined to the vicinity of Indianapolis and other larger municipalities of the basin.

Income from the sale of crops, excluding pasture, fruits and vegetables, and livestock and livestock products in 1959 was $521,800,000

and $473,900,000 respectively(2). Corn, soybeans, wheat, and hay are the principal crops grown in the basin(3). In 1959 the production of feed crops ranked first, food second, roughage third, and livestock and livestock products fourth. Table 1 shows the production of major crops, livestock, and livestock products in the Wabash River Basin in 1959. Farm income is chiefly from cash-grain, livestock, dairy products, and poultry and eggs. Vegetables, fruits, and forest products are minor sources of income. Trends in livestock and poultry production from 1940 to 1964 are as follows:

Hogs - A gradual increase that advanced sharply from 1954 to 1959.

Cattle - A gradual increase.

Sheep - A decrease from 1940 to 1950, an increase to 1959 with a sharp decrease by 1964.

Broilers - A gradual increase from 1954 to 1959 with a sharp decrease by 1964.

Other

Chickens - An increase from 1954 to 1959 with a decrease by 1964 (3) (4).

The production of crops and livestock and livestock products is projected to steadily increase in the forseeable future. Crop production is projected to increase at a slightly greater rate than production of livestock and livestock products. Table 2 shows the projected production of crops, livestock, and livestock products in

the Wabash River Basin for 1980, 2000, and 2020. Production of food crops is projected to increase from 1980 to 2000, then decrease slightly by 2020. Production of feed and roughage crops is projected to steadily increase in the forseeable future. Table 3 shows projected production of food, feed, and roughage crops in the Wabash River Basin for 1980, 2000, and 2020.

Since only 15 percent of the basin is in forest, forest products are a minor source of income. There was, however, 17,325 people employed in the manufacture of lumber, wood products, pulp, paper and allied products in 1962. This figure is projected to increase to 20,358 by 1980, 25,962 by 2000, and decrease to 23,872 by 2020 (2). On commercial forest land as of January 1, 1963, the volume of growing stock was 2,097 million cubic feet and sawtimber was 8,714 million board feet. Timber growth of growing stock on commercial forest land was 84.1 million cubic feet in 1962. This figure is projected to decrease to 63 million cubic feet by 1980, increase to 77 million cubic feet by 2000, and 90 million cubic feet by 2020. Timber cut from growing stock on commercial forest land was 20.7 million cubic feet in 1962. This figure is projected to increase to 37 million cubic feet by 1980, 69 million cubic feet by 2000, and 90 million cubic feet by 2020.

2. Projections (1980, 2000, 2020)

1. Future land uses

Land use trends in the Wabash River Basin are projected as follows:

(a) A decrease in cropland;

(b) acreage of pasture land will more than double;

(c) a slight increase in forest land;

(d) an increase in urban and builtup areas;

(e) an increase in land used for recreation(2).

Table 4 shows projected land requirements in the Wabash River Basin.

During the past 30 years, as a result of increased mechanization in agriculture, farms have increased in size and decreased in number(4). This trend in consolidation of farms is expected to continue into the forseeable future.

Particularly since World War II, more land has been used for roads, cities, industry, reservoirs, and other nonfarm uses. It is expected that agricultural land will continue to be used for these purposes. This means that acreage in farms and cultivated land will decrease. A gradual decrease is projected in the acreage devoted to food, feed, roughage, and miscellaneous crops. Table 5 shows projected areas to be used for crop and pasture production with probable water resource development in the Wabash River Basin. Even with a decreased acreage of cultivated land, crop production is projected to increase through

year 2020. This can be accomplished by means of better land use and management which will include increased use of soil conservation practices, lime and fertilizer, improved crop varieties, better pest control, minimum tillage, increased mechanization, and more irrigation.

Livestock and livestock products, including dairy products and eggs, are projected to steadily increase. Pasture land is projected to increase from 1,503,000 acres in 1980 to 3,420,000 acres by 2020. A part of this acreage will come from crop land.

Land in forest will remain fairly steady. Forest acreage is projected to increase from 3,166,000 acres in 1980 to 3,230,000 acres in 2020. This represents a projected increase of 70,000 acres. With forest land comprising only 15 percent of the basin, radical changes in the acreage of forest land should not be expected.

Since a large part of the basin is projected to remain in cropland, pasture, and forest, widespread use of the most feasible soil conservation practices will be necessary to control erosion, agricultural pollution, and sedimentation of streams and reservoirs.

V. WATER USE

Growing crops use most of the water needed in rural areas. The amount and distribution of precipitation over the Wabash River Basin has generally furnished adequate amounts of water for crops. During the past 30 years, some irrigation has been practiced to offset the effects of dry periods. This has been confined to high value specialty crops. At present, during a year of average rainfall, 5,400 acre-feet are used for irrigation and 7,200 acre-feet are used during a dry year(2). In 1964, 6,752 acres were irrigated in the basin(3).

Livestock and domestic needs are other agricultural water uses. Wells, farm ponds, and streams have generally been used to supply water for these purposes. In the southern unglaciated part of the basin, wells in shale, clay, or siltstone supply only small amounts of water. For over three decades the increased construction of farm ponds has greatly augmented livestock water supplies. Livestock now use 27,180,000 gallons per day. Domestic use is 10,360,000 gallons per day. Rural nonfarm domestic water use is 91,200,000 gallons per day(2).

VI. FUTURE AGRICULTURAL WATER NEEDS (Supply, Flow, and Quality) 1980, 2000, 2020

Future agricultural water needs in the Wabash River Basin will be supplied by surface and ground water sources. With proper planning, the amount and distribution of precipitation should be adequate to maintain needed reservoir water supplies. Ground water recharge should be adequate. There is no prospect at this time of a need to import water from outside the basin.

Projected water supplies needed for livestock and irrigation continue to increase to 2020; needs for irrigation increase at a much greater rate than for livestock. Domestic needs are projected to increase to 1980, then decline to 2020. This is because of a projected decline in farm population. Rural non-farm water needs will continue to grow because more people are projected to move to rural areas. Table 6 shows projected water needs for livestock, rural farm domestic uses, and rural non-farm domestic uses. Table 7 shows the economic potential for agricultural irrigation. Table 8 shows the gross water requirements to satisfy the economic potential for irrigation.

A wide range in water quality can be tolerated for agricultural use. Water for domestic use and dairying should meet the standards set for drinking water. Since most farm families secure their water from wells, a variation in water quality is inevitable. In order to secure good quality water for domestic use and dairies wells should be deep enough to permit sealing out shallow ground water that may become contaminated.

A seal to keep out all surface drainage is also necessary. A periodic test of well water in order to determine its quality is desirable.

Water quality for livestock and irrigation is much less exacting than for drinking water. There should be few problems in securing water of adequate quality for these purposes. The way in which farm ponds are constructed and cared for generally assures good quality water for livestock. Stretches of streams may be too contaminated for livestock water of satisfactory quality. This will generally be limited to downstream from small towns without adequate sewage treatment plants; below outfalls of municipal sewage treatment plants, especially during periods of low flow; areas of acid mine drainage; and oil well brine and industrial pollution.

Water quality suitable for irrigation should generally be satisfactory. Exceptions are water affected by acid mine drainage, high chlorides because of oil well brine pollution, and organic pollution that would make it unsuitable for truck crops such as lettuce, celery, and tomatoes.

Streams affected by acid mine drainage are the lower Patoka River, Busseron Creek, and Sugar Creek in Indiana, portions of Vermilion River in Illinois, and other minor Wabash River tributaries. High chlorides resulting from discharge of oil well brines to streams occur in the lower Patoka and Embarras Rivers, scattered points in the Little Wabash River and Big Creek in Indiana and Bonpas Creek in Illinois, as well as some small streams in oil producing areas(5). Organic pollution may occur downstream from Anderson and Indianapolis on West Fork White River.

At the present time, agricultural irrigation is a minor water use in the Wabash River Basin. During an average year, 5,400 acre feet of water is used to irrigate specialty crops. By 1980, projections indicate more water will be used to irrigate field crops than specialty crops. Projections indicate that increasing amounts of water will be used for irrigation in the forseeable future. By 2020, it is projected that 426,800 acre feet will be used to irrigate field and specialty crops. Over 11 times more water will be used on field crops than on specialty crops. All agricultural uses of water except domestic use are projected to increase. This is necessary if the basin is developed to produce its quota of a projected increased demand for food and fiber.

Agriculture can make a significant contribution toward more efficient water use by putting each acre of land to its best use, using all feasible soil conservation practices, using all practical agronomy practices which will result in the highest possible crop yields, and constructing farm ponds where needed. With proper planning, adequate water supplies should be available in the forseeable future.

As soil conservation practices become more widespread, the quality of runoff water from agricultural land will improve. When feasible soil conservation practices are finally applied to all agricultural land in the basin, silt, nutrient, and pesticide concentrations in runoff water will be reduced to a practical minimum. Water used for irrigation should not adversely affect water quality.

VII. PRESENT WATER QUALITY

1. Effect of Land Use

Nutrients in water appear to be related to land use. Runoff from agricultural areas is much higher in nutrients than runoff from forest areas. Nutrients in runoff from agricultural areas are higher than the threshold that will stimulate nuisance algal blooms in reservoirs; nutrients in runoff from forest areas are below this threshold.

Chemical analyses of water from the French Broad River at Rosman, North Carolina during the 1964 and 1965 water years show an average PO_4 content as P of 0.009 mg/l and NO_3 content as N of 0.05 mg/l. Phosphates only occurred in October, January, and June. The watershed above the sampling station is forest land(6).

Sylvester found nutrients in runoff from forest areas to be much lower than nutrients from agricultural areas(7). This work was done in the State of Washington. Table 9 shows the mean nutrient concentrations for different land uses.

Table 9
Mean Nutrient Concentrations (mg/l)
for Different Land Uses

	Total Phosphorus (P)	Soluble Phosphorus (P)	Nitrates (N)	Total Kjeldahl Nitrogen (N)
Streams from forested areas	0.069	0.007	0.130	0.074
Subsurface irrigation drains (agricultural land)	0.216	0.184	2.690	0.175
Surface irrigation drains (agricultural land)	0.215	0.162	1.250	0.205

Studies made by the Evansville Field Station, FWPCA, of rural runoff from four small watersheds with three different soil associations, show nutrient concentrations higher than the threshold that will stimulate nuisance algal blooms in reservoirs. In this study, soil variations did not affect nutrient concentrations. Table 10 shows mean nutrient concentrations for different soil associations.

Table 10
Mean Nutrient Concentrations (mg/l) for Different
Soil Associations on Agricultural Land

Drainage Area	Soil Association	Percent Crop Land	Total Phos. (P)	Soluble Phos. (P)	Nitrates (N)	Total Kjeldahl Nitrogen (N)
Pike Creek	Blount-Pewamo	87.1	0.120	0.05	1.95	0.99
Rock Creek	Blount-Pewamo	89.3	0.207	0.076	2.48	1.18
Blue River	Morley-Blount	84.6	0.087	0.044	2.00	1.19
Mud Creek	Crosby, Maumee, Miami, and Brookston Loams	89.1	0.101	0.056	2.06	1.42

Sawyer reports that concentrations in excess of 0.01 mg/l of inorganic phosphorus and 0.30 mg/l of inorganic nitrogen at the time of spring overturn can be expected to produce algal blooms of such density as to cause nuisance. This conclusion was reached after analyzing data from 17 lakes in southern Wisconsin(8).

Since a large part of the Wabash River Basin is cultivated, runoff from it can be expected to contain concentrations of phosphorus and nitrogen greater than the threshold that will stimulate nuisance algal blooms in reservoirs.

Algal blooms have been observed in Skillet Fork and other slow flowing streams of the basin. This proves that nitrogen and phosphorus levels in these streams is high enough to stimulate algal blooms. The Skillet Fork Watershed has few towns and little or no industry, so most of the nutrients are of agricultural origin.

Since runoff from well managed forests is low in nutrients and sediments, it should be of good quality and an ideal supply for reservoirs. Also, soil structure is favorable to infiltration of water and facilitates recharge of ground water supplies. In the southern part of the basin, forests are extensive enough to have a local effect on water quality.

Well managed grassland should have about the same effect as forest land on water quality. Nutrients may be a little higher because of the effects of fertilization and livestock wastes. Grassland is not extensive enough in the basin to materially affect water quality.

2. Erosion, land use practices, and sedimentation.

Management practices that result in accelerated soil erosion are prevalent throughout the Wabash River Basin. Seventy-four percent of the basin is crop and pasture land. Most soil erosion occurs on agricultural land. About 65 percent of the basin's agricultural land needs the application of soil conservation practices. Areas left unvegetated during road building, construction of sub-divisions, etc., are also subject to erosion. Any practice which reduces soil cover or which decreases water

infiltration into the soil and restricts deep percolation of water through soils is a potential contributor to accelerated erosion.

The reduction of storage reservoir capacities from sedimentation is virtually a universal problem. Sediments are also a harmful pollutant. They increase the treatment costs for municipal and industrial water supplies. They erode power turbines and pumps, and plug filters. Sediments reduce fish and shellfish populations by blanketing fish nests, spawn, and food supplies to the extent that some species may be eliminated. Suspended sediments reduce the amount of light available to green aquatic plants that help maintain dissolved oxygen supplies in water, thus contributing to problems involved in assimilation of oxygen demanding organic pollutants by streams and lakes.

Sedimentation of streams and reservoirs is directly related to soil erosion. As a result of soil erosion, sediments have been deposited in streams and reservoirs throughout the basin. The reservoir that supplies water for Danville, Illinois is losing capacity at the rate of one percent per year because of sedimentation (9). This gives it a useful life of 65 years and is a measure of the amount of sediment that is being moved by the North Fork Vermilion River. This rate would have been slower had adequate soil conservation practices been applied to the reservoir's watershed.

In the Wabash River Basin much of the cultivated land is gently sloping to level. Consequently, erosion is not so severe as it is on

steeper, cultivated slopes. Nevertheless, soil erosion and subsequent sedimentation needs to be reduced to a practical minimum. This can be achieved by good land use and application and maintenance of suitable soil conservation practices.

Land use is the decisive environmental factor in controlling soil erosion and sedimentation. Runoff from well managed forests and pastures is so low in sediments that erosion and sedimentation is not a problem.

Improper land use of any magnitude has been largely confined to the southern part of the basin. In this area some land has been used for cultivated crops that should have been kept in pasture and some areas have been pastured that should have remained in woodland. A large part of the adjustments in land use that are needed in this area have been made.

Minor basin-wide adjustments in land use can be expected in the future. This can be from cultivated land to pasture; from pasture to woodland; from woodland to cultivated or pasture; or from pasture to cultivated land. Agricultural land will continue to be taken for cities, roads, recreation areas, etc. Cultivated land will be cropped more intensively, making the application of soil conservation practices more urgent than ever before.

Precipitation intensity and duration and other climatic factors such as temperature strongly influence soil erosion and subsequent stream sediment concentrations. Important environmental factors are topography,

soil type, vegetation, and land use. Data have been cited by Stall(10) indicating that three-fourths of the soil loss from experiment station plots at seven locations throughout the United States occurred during four storms a year. Furthermore, on the basis of these and other data, he concluded that the major portion of the sediment is carried downstream during flows that occur three or four times a year. This means that 67 to 75 percent of the soil loss must occur during about one percent of a year's time, and is in line with the observation that the sediment load of most streams increases exponentially with increase in water discharge. Methods effective in holding down soil losses during critical storm periods would reduce significantly the sediment load potential.

Areas in the process of urban development have been observed where bulldozing is widespread and large areas of bare soil are exposed to erosion. This greatly increases the load of suspended sediments in runoff water from areas affected by urbanization. The transition from rural to urban use cannot be overlooked.

Urban and builtup areas in the Wabash River Basin are projected to increase from 1,451,000 acres in 1980 to 2,441,000 acres in 2020; an increase of 990,000 acres.(2) During the construction period, all feasible means should be used to control erosion and sediment loads to streams and reservoirs. After construction is completed, these areas should be stabilized so that the only important change from former conditions

will be an increase in runoff. These same principles should be applied during and after highway construction.

3. Agricultural chemicals.

The principal agricultural chemicals used in the Wabash River Basin are pesticides, fertilizer, and lime. Pesticides are used on both plants and animals.

In 1964 1,093,340 tons of fertilizer were applied to 7,370,203 acres of cropland in the basin(3). The principal crops fertilized included corn, wheat, soybeans, and hay. Some pasture land was fertilized. The pounds of fertilizer applied per acre and number of acres fertilized has steadily increased, particularly since World War II. This trend is expected to continue. In order to reduce the amount of nitrogen and phosphorus that may be carried into streams by runoff water, the best feasible soil conservation program should be applied to the land and no more than optimum amounts of fertilizer should be used. Only low concentrations of phosphorus and nitrogen are necessary to stimulate nuisance algal blooms in reservoirs. Algal blooms, upon dying and decomposing, adversely affect water quality by imparting taste and odor problems.

In 1964 2,209,026 tons of lime were applied to 885,576 acres of cropland. It is doubtful that the use of lime on cropland will significantly increase the hardness of runoff water to the point that water quality is adversely affected.

In 1964 pesticides were used on 4,061,136 acres of cropland or about 19 percent of the basin's area. Crops most commonly treated are corn, small grain, hay, seed crops, vegetables, fruits, and pasture. Cattle, hogs, and sheep are treated externally to control insects. The most intensive use of pesticides is on fruit and vegetable crops. Pesticides most commonly used are aldrin, amiben, atrazine, carbaryl, diazinon, heptachlor, malathion, trifluralin, and 2,4-D.

We cannot be sure what the cumulative or future long term effects of pesticides will be. Every effort should be made to keep the amount of pesticide residue on food to the lowest extent compatible with good insecticide and farming practices. If pesticides are used according to instructions, there is little danger that surface runoff will carry enough of them into streams to contaminate the water. At this time there is no evidence that agricultural use of pesticides has grossly contaminated any streams in the basin. It is considered unlikely that more than trace amounts of pesticides may ever penetrate underground into aquifers.

More should be known about the ultimate fate of pesticides following their application to plants, animals, or soils. There are many factors that may influence chemical changes, and the rates of such changes depend both on the nature of the compound and the conditions to which it is subjected. The reactions that occur may produce compounds of greater toxicity than the original product. Frequent applications of some insecticides may result in an undesirable accumulation of residues in some soils.

4. Runoff from large feedlots.

County extension agents reported a total of 1,082 large cattle and hog feedlots in the Wabash River Basin. All but 21 treated animal wastes by spreading them on the land or in lagoons. Storm water runoff carrying untreated animal wastes may have a local effect on water quality in the Wabash River Basin.

VIII. WATER QUALITY CONTROL

1. Agricultural Pollution.

(1) Soil erosion and sedimentation.

In order to maintain good water quality all pollution, including agricultural pollution, must be held to a feasible minimum. Sediments, as a consequence of soil erosion, are considered to be the most serious contribution of agriculture to water pollution. With 74 percent of the Wabash River Basin in crop and pasture land, and 65 percent of this land needing the application of soil conservation practices, silt pollution of streams is a consequence of every storm of any magnitude. Table 11 shows major land use of the Wabash River Basin in 1959. Since most of the cropland is cultivated, a source of silt is readily available for storm water to carry into streams. Table 12 shows the use of cropland and pasture land in the Wabash River Basin in 1959.

Land use is the decisive factor in controlling soil erosion and sedimentation. Regardless of soil type, a dense sod or a well managed forest effectively controls soil erosion. But agricultural production is based largely on field and row crops that require cultivation of the land.

Soil type is an important factor governing the severity of erosion on cultivated land. Sloping soils are usually more erosive than nearly level soils. On comparable slopes, soils with high infiltration and percolation capacities are less erosive than soils with low infiltration and percolation capacities. Although much of the cultivated land in the

Wabash River Basin is level to gently sloping, it ranges from moderate to very low in infiltration and percolation capacities. As a consequence, a large part of the cultivated land in the basin is subject to serious soil erosion. Conservation treatment needs of cropland show that soil erosion is a dominant problem on 2,429,600 acres and a secondary problem on 355,100 acres. Table 13 shows the conservation treatment needs for cropland in the Wabash River Basin. Conservation treatment needs of pasture land and woodland show that protection from erosion is needed on 95,500 acres of pasture land and 48,800 acres of woodland. Table 14 shows the conservation treatment needs for pasture land and woodland in the Wabash River Basin.

Rains that result in significant amounts of runoff result in muddy streams at any point in the basin that they occur except in areas that are largely forested. Proper land use accompanied by the application of feasible soil conservation practices must be achieved as rapidly as possible for the entire Wabash River Basin. Until this is accomplished, excessive soil erosion, silt pollution of streams and reservoirs, and sedimentation of streams and reservoirs will continue to be problems.

(2) Nutrients from agricultural runoff.

Nutrients in runoff from agricultural land are much too dilute to directly affect water quality in the Wabash River Basin. Drainage during the spring months from farm land in the Vermillion River Basin is an exception. The nitrate content of water samples collected by the

Evansville Field Station, FWPCA, from tile drains in this area, May 9, 1967 ranged from 53 to 79 mg/l. This area will receive further study. Ground water here could be dangerously high in nitrates. Studies of agricultural runoff in some small watersheds in the upper Wabash River Basin by the Evansville Field Station, FWPCA, show nutrient concentrations greater than that necessary to stimulate nuisance algal blooms in reservoirs. Nuisance algal blooms, upon dying and decomposing, affect water quality by imparting disagreeable tastes and odors to water supplies.

The basin is mostly used for farm crops, except for the southern part which is largely forested. From the information at hand, it is reasonable to expect runoff from the cropland to contain concentrations of nutrients greater than are needed to stimulate nuisance algal blooms in reservoirs. Land use in this area may be more important than soil type in regard to nutrient concentrations in agricultural runoff. No marked difference in nutrient concentrations in runoff from agricultural land was found when nearly level to gently sloping, moderately permeable soils were compared to nearly level to gently sloping slowly permeable soils.

(3) Kinds and amounts of pesticides and crops for which they are used.

Pesticides most commonly used in the Wabash River Basin are aldrin, amiben, atrazine, carbaryl, diazimon, heptachlor, malathion, trifluralin, and 2,4-D. In 1964 pesticides were used on 4,061,136 acres of cropland or about 19 percent of the basin's area. Crops most commonly

treated are corn, small grain, hay, seed crops, vegetables and fruits. Cattle, hogs, and sheep are treated externally to control insects. The most intensive use of pesticides is on fruit and vegetable crops. Amounts of pesticides used are not known. Oral communications with pesticide authorities at the University of Illinois and Purdue University indicate that users of pesticides adhere quite well to the recommended amounts, and that as long as recommended usage is adhered to, no gross pesticide pollution problems are expected.

There are several sources by which water may be polluted by pesticides: (1) pesticides may enter surface water by runoff from treated agricultural or forest land, (2) they may be applied directly to water surfaces to control mosquitoes and weeds or to eradicate rough fish, (3) pesticides may drift into water from aerial applications to agricultural land, (4) by discharge of wastes from the manufacture of pesticides, from formulation of commercial products, and from washing and processing fruits and vegetables, and (5) by washing spray equipment and discharge of excess spray material in surface water.

(4) Size, Kind, and Number of Large Feed Lots.

Table 15 shows the size, kind, and number of large livestock feed lots and how their wastes are treated. A canvass of county extension agents produced the following information. Wastes from 596 cattle feed lots are spread on the land, two are treated in lagoons, and 11 are not spreading or treating wastes. Wastes from 332 hog feed lots are spread on the land, 99 are treated in lagoons, and 10 are not spreading or

treating wastes. Most of the livestock wastes seem to be handled in a satisfactory manner to prevent stream pollution. The 21 feed lots that do not spread or treat wastes are a likely source of pollution of surface water. A total of 1,082 large feed lots are reported in the Wabash River Basin.

2. Reduction in Pollution from Surface Runoff.

Any effective means in reducing the rate and amount of runoff may result in a reduction of pollution from the ground surface. Since 65 percent of the basin's agricultural land needs the application of soil conservation practices, 100 percent application of these practices will reduce runoff and pollution significantly. All cultivated and pasture land should be treated with every feasible soil conserving practice. Although the amounts of nitrates, phosphates, and pesticides carried into streams are small, complete conservation treatment of the basin should reduce the levels of these compounds as much as it is practical to achieve. Also, not more than the optimum amounts of fertilizers should ever be used. When pesticides are used, care should be taken to apply them only to the crop to be treated and in the recommended amount.

3. Reduction of Toxic Contaminant Sources.

Selective use of pesticides and the use of alternate methods of pest control would reduce toxic, contaminant sources of agricultural origin.

Research will undoubtedly develop more chemical and biological choices that may be used to control specific pests. Desirable chemical alternatives should be non-toxic to all organisms other than the pest or pests to be controlled. Rapidly degradable agents should replace non-degradable or slowly degradable agents for pest control wherever feasible. Pesticides should never be used in excess of the maximum recommended amounts. Excess spray material should never be discharged into surface water and spray equipment should not be washed in uncontrolled surface water. A sound program of soil conservation will lower the amount of pesticides entering surface water from treated farm land.

Proper housekeeping procedures by manufacturers should minimize pollution and contamination by pesticides. Manufacturers of pesticides should never discharge untreated wastes from their manufacturing processes into surface water.

IX. REFERENCES

(1) Soils of the North Central Region of the United States, Agricultural Experiment Station, University of Wisconsin, Madison, June 1960. Bulletin 544, North Central Regional Publication 76.

(2) Ohio River Basin Comprehensive Survey, Volume VII, Appendix F, Agriculture, 1966.

(3) United States Census of Agriculture, 1964.

(4) United States Census of Agriculture, 1959.

(5) Ohio River Basin Comprehensive Survey, Volume V, Appendix D, Water Supply and Water Pollution Control.

(6) Water Resource Data for North Carolina, Part 2, Water Quality Records, U. S. Department of the Interior, Geological Survey, 1965.

(7) Sylvester, R.O., 1961, Nutrient Content of Drainage Water From Forested, Urban, and Agricultural Areas. Algae and Metropolitan Wastes, U. S. Public Health Service, SEC TR W61-3, pp. 80-87.

(8) Sawyer, C. N., 1952, Some New Aspects of Phosphates in Relation to Lake Fertilization. Sewage and Industrial Wastes, Vol. 24, No. 6, pp. 768-776.

(9) Vermilion River Basin Study, Illinois Division of Waterways, 1967.

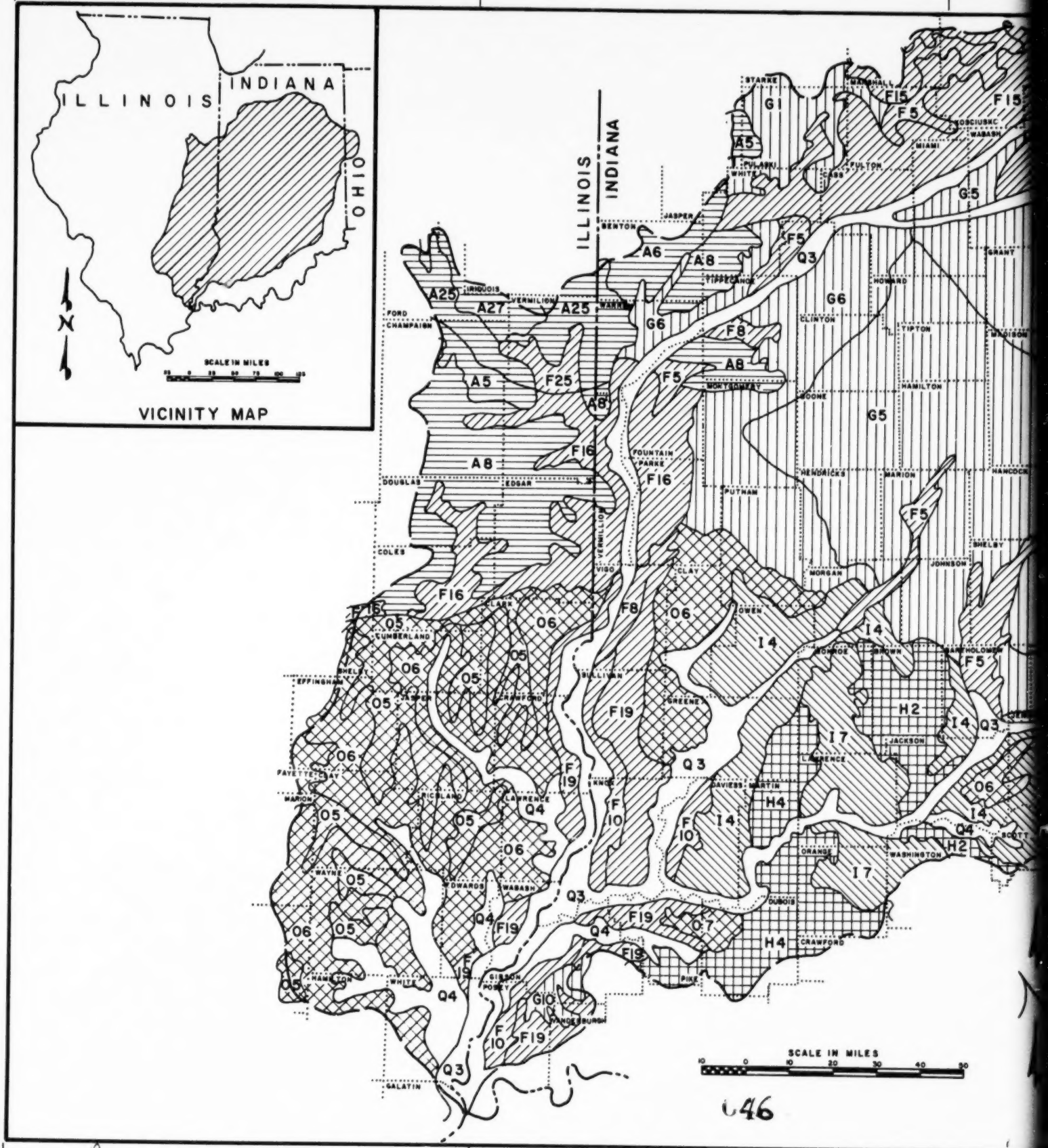
(10) Stall, J. B., Sediment Movement and Deposition in Illinois Impounding Reservoirs, Journal American Water Works Assn., Vol. 56, No. 6, pp. 755-766, 1964.

Other References

A - Weidner, R. B., Christianson, A. G., Weibel, S. R. and Robeck, G. C., Rural Runoff as a Factor in Stream Pollution. U. S. Department of the Interior, Federal Water Pollution Control Administration. January 1968.

B - Miller, William E. and Tash, Jerry C., Interim Report Upper Klamath Lake Studies Oregon, Publication No. WP-20-8, U. S. Department of The Interior, Federal Water Pollution Control Administration. September 1967.

APPENDIX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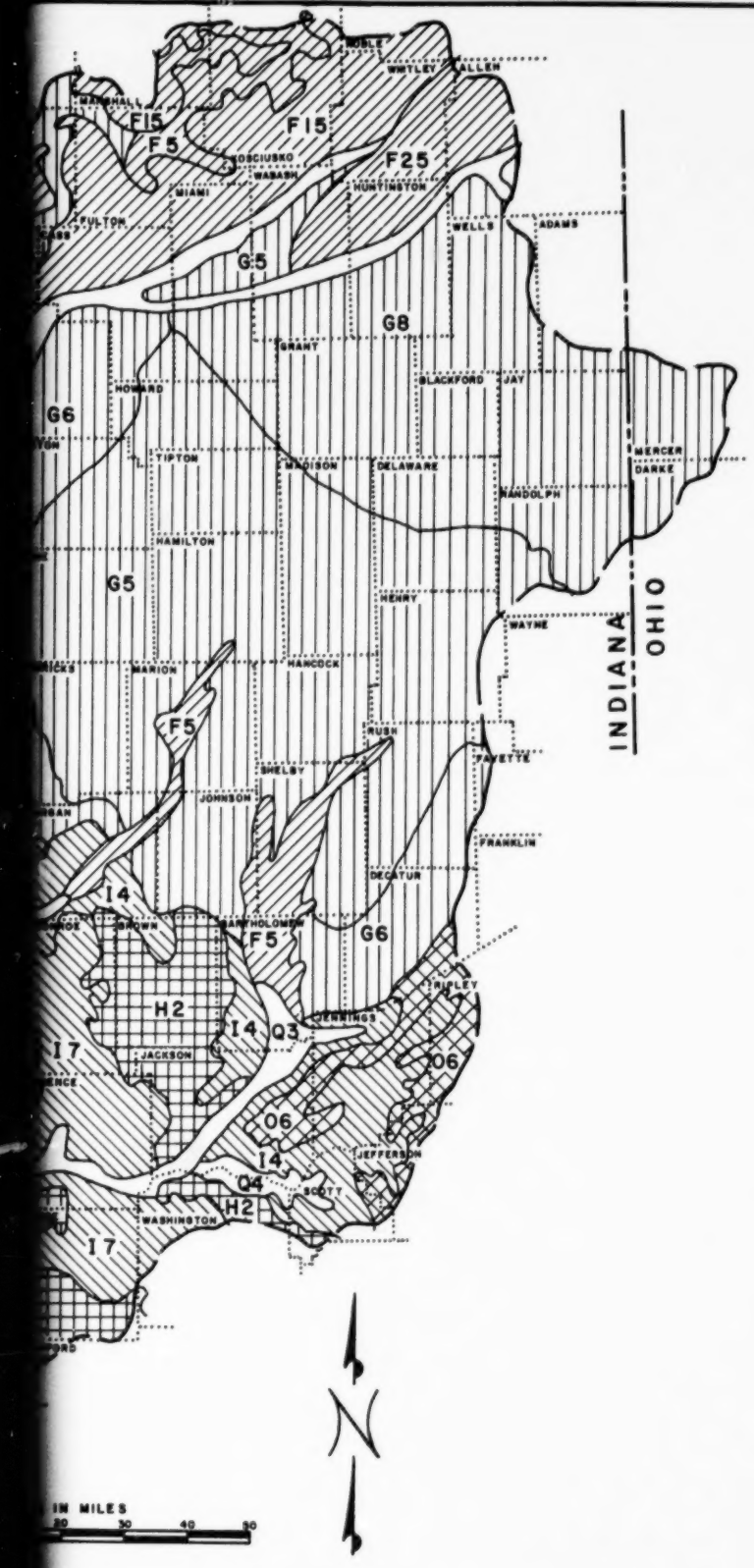

LEGEND

A — WELL TO VERY POORLY DRAINED PRAIRIE SOILS

- A5 Brenton-Martinton-Rensselaer
- A6 Saybrook-Parr-Drummer
- A8 Flanagan-Drummer-Sidell
- A25 Elliott-Ashkum
- A27 Swygert-Bryce-Clarence

F — GRAY BROWN PODZOLIC

- F5 Fox-Oshtemo-Warsaw
- F8 Tracy-Door
- F10 Princeton-Bloomfield
- F15 Miami-Crosby
- F16 Birkbeck-Pecatonica-Russell
- F19 Menfro-Alford-Hosmer
- F25 Morley-Blount-Pewamo

G — GRAY BROWN PODZOLIC AND HUMIC GLEY

- G1 Plainfield-Granby-Zimmerman
- G5 Miami-Crosby-Brookston
- G6 Russell-Fincastle-Brookston
- G8 Blount-Pewamo-Morley
- G10 Montgomery-McGary

H — GRAY BROWN PODZOLIC AND LITHOSOL

- H2 Muskingum-Keene-Wellston
- H4 Muskingum-Zanesville

I — GRAY BROWN PODZOLIC AND RED-YELLOW PODZOLIC

- I4 Cincinnati-Rossmoyne-Fairmont
- I7 Frederick-Crider-Pembroke

Q — PLANSOL

- Q5 Hoyleton-Cisne
- Q6 Bluford-Vigo-Clermont
- Q7 Robinson-Otwell

Q — ALLUVIAL

- Q3 Genesee-Huntsville-Wabash
- Q4 Waverly-Bonnie-Philo

EFFECT OF AGRICULTURE ON WATER QUALITY AND USE
WABASH RIVER BASIN
ILLINOIS - INDIANA - OHIO

SOIL ASSOCIATION MAP

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
EVANSVILLE FIELD STATION, INDIANA OHIO RIVER BASIN PROJECT

FIGURE 1

TABLE 1

Production of Major Crops, Livestock and Livestock Products
Wabash River Basin, 1959(2)

Crops				Livestock & Livestock Products 3/
Food 1/	Feed 2/	Roughage 2/	Total	
		(THOUSAND TONS)		
3,052.9	8,915.1	2,824.2	14,792.2	2,106.6

1/ Excludes fruits and vegetables.

2/ Excludes crops of minor importance.

3/ Includes dairy products and eggs.

TABLE 2

Projected Production of Crops, Livestock and Livestock Products
Wabash River Basin, 1980, 2000, and 2020[2]

1980		2000		2020	
Crops 1/	Livestock & Livestock Products 2/	Crops 1/	Livestock & Livestock Products 2/	Crops 1/	Livestock & Livestock Products 2/
(THOUSAND TONS)					
23,657.6	3,308.9	27,689.5	4,553.6	31,547.3	5,800.5

1/ Excludes pasture, fruits, vegetables, and crops of minor importance.

2/ Includes dairy products and eggs.

TABLE 3

Projected Production of Food and Feed Crops and Crop Roughages
Wabash River Basin, 1980, 2000, and 2020(2)

1980				2000				2020			
Food Crops 1/	Feed Crops 2/	Roughage Crops 2/	Total	Food Crops 1/	Feed Crops 2/	Roughage Crops 2/	Total	Food Crops 1/	Feed Crops 2/	Roughage Crops 2/	Total
(THOUSAND TONS)											
5,385.8	13,879.2	4,392.6	23,657.6	5,663.2	17,413.9	4,612.4	27,689.5	5,642.1	21.083.7	4,821.5	31,547.3

1/ Excludes fruits and vegetables.

2/ Excludes crops of minor importance.

TABLE 4

Projected Land Requirements, Wabash River Basin(2)

Year	Total Land Area	Land Area Needed					Remaining Lands 1/
		Cropland	Pasture	Forest	Urban & Builtup	Subtotal	
		(THOUSAND ACRES)					
1980	20,886	11,714	1,503	3,166	1,451	17,834	3,052
2000		10,807	2,206	3,190	2,032	18,235	2,651
2020		10,492	3,420	3,230	2,441	19,583	1,303

1/ Includes: a. Land areas presently being used for farmsteads, rural non-farm residences, crossroad service stations, rural schools and churches, wastelands, etc.

b. Land areas that might be available for resource development (water and land), recreation, fish and wildlife, flood prevention, municipal and industrial water supplies, irrigation, water quality control, etc.; without impacting crop, pasture, forest and urban needs.

TABLE 5

Projected Area to be Used for Crop and Pasture Production
With Probable Water Resource Development
Wabash River Basin (2)

Year	Crops				Pasture	Total
	Food	Feed	Roughage	Misc.		
			(THOUSAND ACRES)			
1980	4,650	5,557	1,179	328	1,503	13,217
2000	4,481	5,398	615	313	2,206	13,013
2020	4,306	5,109	770	307	3,420	13,912

052

TABLE 6

Projected Needs for Water for Livestock, Rural Farm Domestic Uses, and Rural Non-farm Domestic Uses, Wabash River Basin[2]

Livestock				Rural Farm Domestic				Rural Non-farm Domestic			
Million gallons per day needed in				Million gallons per day needed in				Million gallons per day needed in			
Present	1980	2000	2020	Present	1980	2000	2020	Present	1980	2000	2020
27.18	45.95	72.20	98.20	10.36	11.62	10.24	9.03	91.2	97.4	122.6	148.7

TABLE 7

Economic Potential for Agricultural Irrigation
Wabash River Basin 1/ (2)

Present		Economic Potential in:					
		1980		2000		2020	
Specialty Crops	Field Crops	Specialty Crops	Field Crops	Specialty Crops	Field Crops	Specialty Crops	Field Crops
				(THOUSAND ACRES)			
8.9	--	34.4	58.4	511	318.3	66.3	725.2

1/ Economic Potential for Agricultural Irrigation for each Projection Year is a gross estimate which includes existing irrigation.

053

TABLE 8

Gross Water Requirements to Satisfy the Economic Potential
for Irrigation, Wabash River Basin(2)
(Based on average and driest year of record)1/

Estimated Present Use				1980				2000				2020			
Specialty Crops		Field Crops		Specialty Crops		Field Crops		Specialty Crops		Field Crops		Specialty Crops		Field Crops	
Avg. Year	Driest Year	Avg. Year	Driest Year	Avg. Year	Driest Year	Avg. Year	Driest Year	Avg. Year	Driest Year	Avg. Year	Driest Year	Avg. Year	Driest Year	Avg. Year	Driest Year
(THOUSAND ACRE FEET)															
5.4	7.2	---	---	19.6	28.4	28.6	39.0	28.1	38.8	159.1	217.7	35.2	48.6	391.6	533.9

1/ Water requirements for each projection year is a gross estimate which includes existing irrigation water use and is based on 75 percent application efficiency. Does not include storage or abnormal transmission losses.

TABLE 11

Major Land Use, Wabash River Basin, 1959(2)

Total Geographic Area 1/	Water Areas			Land Area					
	Total	40 Acres or More 1/	Less Than 40 Acres 2/	Total 3/	Urban & Builtup 3/	Cropland 2/	Pasture 2/	Forest 4/	Other 5/
				(THOUSAND ACRES)					
21,018	132	48	84	20,886	1,010	13,412	2,074	3,134	1,256

1/ Bureau of the Census, Land & Water Areas of the United States, 1960.

2/ U. S. Department of Agriculture, National Inventory of Soil and Water Conservation Needs, 1962.

3/ Total geographic area minus total water area.

4/ Calculated as residuals from information assembled in the National Inventory of Soil and Water Conservation Needs. Forest acreages reported here differ somewhat from U. S. Forest Service estimated which are based on the Forest Survey.

5/ National Inventory of Soil and Water Conservation Needs. Includes farmsteads, abandoned land, wildlife areas, crossroad filling stations, rural non-farm residences, country schools and churches, etc.

TABLE 12

Use of Cropland and Pasture Land, Wabash River Basin, 1959[2]

Crops				Pasture	Idle 5/	Total
Food 1/	Feed 2/	Roughage 3/	Miscellaneous 4/			
			(THOUSAND ACRES)			
3,991	5,655	1,199	342	2,074	2,225	15,486

1/ Includes wheat, soybeans, dry field beans, and potatoes.

2/ Corn, oats, and barley.

3/ Corn silage, alfalfa mixtures, other hay, and cropland pasture.

4/ Fruits, vegetables, and miscellaneous small grain.

5/ Cropland acreage reported in the National Inventory of Soil and Water Conservation Needs minus the total acreage of crops reported in the 1959 Census of Agriculture. Includes cropland idled by Government programs, and land planted but not harvested.

TABLE 13

Conservation Treatment Needs for Cropland, Wabash River Basin (2)

Land on which the Dominant Problem is Erosion	Secondary Problem			Land on which the Dominant Problem is Excess Water	Secondary Problem			Land on which the Dominant Problem is Unfavorable Soil Conditions	Secondary Problem		
	None	Excess Water	Unfavorable Soil Conditions		None	Erosion	Unfavorable Soil Conditions		None	Erosion	Excess Water
					(ACRES)						
2,429,600	1,658,100	554,400	217,100	4,762,500	4,114,700	47,900	599,900	307,200	--	307,200	--

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TABLE 14

Conservation Treatment Needs for Pasture Land and Woodland, Wabash River Basin[2]

PASTURE LAND						WOODLAND					
Establishment or Reestablishment of Vegetation	Improvement of Vegetative Cover	Protection from			Control of Excess Water	Establishment of Tember Stands	Improvement of Timber Stands	Protection from			Erosion Control
		Overgrazing	Erosion	Encroachment of Plants				Fire	Insects and Diseases	Animals	
(ACRES)											
625,100	300,200	205,600	95,500	79,600	39,000	289,100	1,211,600	2,064,000	1,867,900	851,700	48,800

TABLE 15

SIZE AND NUMBER OF LARGE FEEDLOTS AND HOW WASTES ARE MANAGED

Size of Herd	Number of Herds Fed in Dry Lot or Barn	Number That Spread Wastes on Land	Number That Treat Wastes in Lagoons	Number Not Spreading or Treating Wastes	Number of Herds Fed on Pasture and Finished in Dry Lot	Total Number of Herds
CATTLE						
200 to 300	378	397		6	159	432
300 to 500	144	139		2	54	151
500 to 1000	56	53	2	2	6	60
1000 to 2000	6	6				6
2000 to 3000	2	1		1		2
HOGS						
1000 to 2000	309	261	73	9	180	326
2000 to 3000	77	59	17	1	21	84
3000 to 4000	19	11	8		5	19
4000 to 5000	1		1			1
over 15,000	1	1				1

Definitions: Herd Size - Number of animals on feed at a given time.
Lagoon - A method of treating wastes in a shallow pond that reduces their pollution potential.